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Part 2. Biochemical Components of the Blood and Serum of the "Greer-Radeleff" Line of American-Essex Swine

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ABSTRACT

Eighteen biochemical components of blood and serum were determined on 14 female and 11 male Greer-Radeleff swine—a breed of American-Essex swine—ranging from 4 to 67 months of age at the start of the study. Samples were taken every 28 days for 12 months. Females had significantly higher levels of copper and significantly lower levels of albumin, creatinine, and urea nitrogen. Levels of calcium, iron, inorganic phosphorus, potassium, zinc, uric acid, glucose, and α-globulin were higher in females, but not significantly so, and magnesium, sodium, cholinesterase, total protein, β-globulin, and γ-globulin were lower in females, but not significantly so. **KEY WORDS: American-Essex swine, blood chemistry of livestock, blood chemistry of swine, normal biochemical components of American-Essex swine, swine.**

INTRODUCTION

Swine have been used in biomedical research since as early as 1500, when Leonardo da Vinci used pigs to demonstrate the movement of the heart during the cardiac cycle. Until recent years, however, domestic swine have not been widely used in biomedical research, probably because of their size at maturity and difficulty in handling. In 1949, the Hormel Institute, University of Minnesota, initiated a breeding program to develop miniature swine that fulfilled specific anatomical and physiological requirements for research relating to men. Many biomedical parameters for domestic swine and other experimental animals are contained in the Handbook of Biological Data.[2] Data on the miniature swine were reported in "Swine in Biomedical Research."[3]

At the Veterinary Toxicology and Entomology Research Laboratory, we needed a pig of an established breed that would both represent swine rather than men and retain the primary advantages of the miniature pig (size and economy). The pigs should also be docile, productive, and adaptable to the outdoor climate of Southwest Texas. They should breed true, reflect normal biochemical and physiological values, and have normal swine reactions to toxic substances.

At one time a breed known as the American-Essex was commonly raised for food in the ranching areas of Southwest Texas. We found

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[2] Spector, W. A. 1956. Handbook of biological data. 53 pp. W. B. Saunders, Philadelphia.

[3] Bustad, L. K., McClellan, R. O., and Burns, M. P., 1966. Swine in biomedical research. Proceedings of Symposium. Pacific Northwest Laboratory, Battelle Memorial Institute, Frayn Printing, Seattle.

one such herd in 1967 on a ranch in the Hill Country area of West Texas. Established in 1916, the herd had been closed since 1919. The pigs were small and black with a russet tinge in the hair, and appeared to breed true through natural selection. Known locally as Guinea-Essex or Guineas, they conformed to the description, pictures, and personal recollections of experienced individuals at Texas A&M University as being representative of the American-Essex breed.

Four bred gilts were purchased by the laboratory. We named the offspring Greer-Radeleff, or "G–R," pigs after the owner of the parent stock and the initiator of the revival of the stock, respectively.

The "G–R" line of swine meets the qualifications of an excellent animal for biomedical research, and the normal values for 18 biochemical components of blood and serum are reported in this paper.

EXPERIMENTAL PROCEDURE

We used 25 "G–R" pigs—14 female and 11 male—ranging from 4 to 67 months of age at the time of the initial samples. The pigs were kept in individual 6- by 8-foot pens on smooth concrete slabs with a galvanized cyclone fence. Each pen contained either a small wooden shelter (commercial doghouse) or a metal shelter (two-can garbage storage unit) of equivalent size. Fresh water was available at all times. Twice a day the pigs were hand-fed a commercial nonmedicated feed containing approximately 14 percent crude protein, those from 4 to 6 months of age getting 300 grams per feeding, those from 6 months to 1 year, 400 grams, and those over 1 year, 500 grams. The ration was basically a sorghum grain and soybean meal mixture containing animal protein products, dehydrated alfalfa-leaf meal, processed grain byproducts, and cane molasses, supplemented with vitamins, minerals, and salt.

Individual blood samples were collected by venipuncture of the anterior vena cava every 28 days for 12 months. Whole blood with EDTA (ethylenediaminetetraacetic acid, disodium salt) as the anticoagulant was used for cholinesterase determinations by a modified Michel procedure. Serum collected by double centrifugation was used for all other determinations.

A single channel Technicon Auto-Analyzer with N-clinical methods was used to determine levels of inorganic phosphorus, glucose, uric acid,

TABLE 1.—*Levels of whole-blood and serum components of "G–R" pigs*

Component		All animals[1]		Females[2]		Males[3]	
		Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Total calcium	mg/100 ml	15.9	2.1	16.1	2.6	15.8	1.8
Copper	mg/100 ml	0.264	0.024	0.275	0.026	0.253	0.029
Iron	mg/100 ml	0.303	0.109	0.336	0.117	0.269	0.099
Magnesium	mg/100 ml	2.66	0.16	2.63	0.18	2.70	0.16
Inorganic phosphorus	mg/100 ml	5.73	0.50	5.81	0.49	5.64	0.52
Potassium	mg/100 ml	26.0	3.2	26.4	3.6	25.5	2.7
Sodium	mg/100 ml	346	15	345	19	347	13
Zinc	mg/100 ml	0.092	0.013	0.094	0.015	0.090	0.013
Creatinine	mg/100 ml	2.16	0.32	1.91	0.29	2.46	0.35
Urea nitrogen	mg/100 ml	15.2	0.7	14.7	0.7	15.7	1.0
Uric acid	mg/100 ml	0.20	0.08	0.21	0.08	0.19	0.08
Glucose	mg/100 ml	85	9	86	10	83	9
Cholinesterase (whole blood)	Δ pH	0.27	0.02	0.26	0.03	0.27	0.03
Total protein	g/100 ml	8.97	0.43	8.84	0.36	9.12	0.55
Albumin	g/100 ml	3.76	0.16	3.64	0.20	3.91	0.16
α-Globulin	g/100 ml	1.29	0.08	1.31	0.10	1.27	0.07
β-Globulin	g/100 ml	1.83	0.18	1.81	0.14	1.86	0.24
γ-Globulin	g/100 ml	2.11	0.30	2.10	0.25	2.12	0.35

[1] 287 samples; 13 samples were not taken or lost.
[2] 157 samples; 11 samples were not taken or lost.
[3] 130 samples; 2 samples were not taken or lost.

urea nitrogen, creatinine, and total protein. Calcium, magnesium, potassium, sodium, zinc, copper, and iron were determined with a Perkin-Elmer model 403 atomic absorption spectrophotometer, according to procedures outlined in the Perkin-Elmer manual. Albumin and α-, β-, and γ-globulin were determined with a Beckman Microzone electrophoresis system.

RESULTS AND DISCUSSION

The means and standard deviations of the biochemical components for all animals, females, and males are given in table 1. Of the 18 components determined, only 4 showed any sex difference: the females had significantly higher levels of copper ($P>0.05$), and the males had significantly higher levels of albumin ($P>0.005$), creatinine ($P>0.0005$), and urea nitrogen ($P>0.01$). The difference in both iron and total protein approached significance at the 10-percent level. Levels of calcium, iron, inorganic phosphorus, potassium, zinc, uric acid, glucose, and α-globulin were higher in females, but not significantly so, and magnesium, sodium, cholinesterase, total protein, β-globulin, and γ-globulin were lower in the females, but not significantly so.

With the exception of total calcium and copper, our values either closely approximate the mean value or fall within the range given in the Handbook of Biological Data. Both total calcium and copper levels were higher. Methods of analysis could account for this difference because atomic absorption procedures give higher values than colorimetric methods.

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